Prof. Monier Williams might not accept this view, but we recommend his book as at once a scholarly and a practical exposition of Hinduism, in a cheap and popular form.

Mr. Rhys Davids has done his work well, but with a difference, in his little volume on Buddhism. He has rightly separated the facts (so far as we can ascertain them) of the history of the founder from the modern legends regarding him. He gives a careful and interesting narrative of the life, explains the doctrines which Gautama Buddha taught, and the system of morals which was subsequently based upon his precepts and example. Nothing could be better than some of the passages which bear upon the aspects of Buddhism in Ceylon, China, and Tibet. But it is to be regretted that the plan of the work permitted of so little space for its influence upon the mediæval forms of Indian ritual and belief. One of the most interesting pictures which we possess of a struggle between two great faiths is to be found in Hiouen Thsang's itinerary through India in the seventh century. The narratives of the Chinese travellers form, indeed, the first historical evidence of eye-witnesses with regard to Indian manners and beliefs. They supply a key to the subsequent religious developments among the Hindus, and well merit a fuller notice. Another point of deep interest on which Mr. Rhys Davids' volume is, perhaps necessarily, silent, refers to the industrial aspects of Buddhism. It is well known that architecture in India began with the requirements of Buddhism, and that those requirements profoundly affected its whole subsequent history. Moreover, the Buddhist monks were not only missionaries; they were artists, or at any rate artisans, who carried a new civilisation as well as a new faith to the Asiatic races. Thus it was a Buddhist monk of Corean ancestry who, between 662 and 672 A.D., published the secret of making translucent pottery in Japan. The ritual of Buddhism stamped its influence on the characteristic national industry both of Japan and China; and as late as 1212 we hear of a celebrated Japanese potter, accompanied by a Buddhist monk, going on a mission to the mainland to acquire the deeper mysteries of ceramic art. The vast number of Buddhist records did much to develop the art of writing, while the circumstance that its theology centres around a single human life, gave a biographical and historical impulse to the nations who adopted it, which is unknown among the followers of the older Bráhmanical faith. Mr. Rhys Davids' book is silent on these points. But it is only just to him to add that he has managed to compress a vast amount of thought and information, of a kind perhaps more important from the Society's point of view, into his 250 pages.

Mr. Stobart's Islám is conceived in a less philosophical spirit. "Light and darkness," he says, "are not more opposed than the loving doctrines of the Gospel and the vengeful spirit of the Koran." "Darkness and retrogression are engraved on every page of the Preserved Book." This is his conclusion of the whole matter, but it fails to explain the secret of one of the great historical movements which has deeply influenced mankind. Scraps of piety are scattered throughout the book, sometimes with a curious effect. Here is Mr. Stobart's conception as to how a chapter on the Ancestry of Mahomet should begin:—"We have the assurance that Noah was 'a perfect man and walked with God' (Gen. vii. 9); and as a 'preacher of righteousness' (2nd Peter, ii., 5), having with his sons been witness of the flood, handed down to his posterity the worship of the True God." Further quotation is unsuitable. Mr. Stobart's book will supply a convenient but misleading compendium for those who wish to know a little about the subject. It reproduces the bigotry which disfigured Sir William Muir's "Life of Mahomet," on which it is chiefly based, without the scholarship which rendered that Indian civilian's four volumes the standard English work on Islám.

OUR BOOK SHELF

Physical Chemistry. By N. N. Lubavin. Part II. 8vo. 460 pp. (Russian). (St. Petersburg, 1877.)

We are glad to notice the appearance of the second and last part of M. Lubavin's most valuable work, which is devoted to the most important departments of physical chemistry. In this part the author deals with chemical reactions in general and discusses under this head some of the various theories advanced as to the distinctive characters of chemical processes; the stechiometrical laws of Dalton, Gay-Lussac, Faraday, Dulong and Petit, &c., all figures relative to these laws being given in a tabular form; chemical combinations, *i.e.*, the formation of compounds by heat, light, and electricity, and under the influence of other bodies; the development of energy during chemical processes, this chapter containing nineteen very useful tables; changes of properties of bodies when entering into chemical combinations; the decomposition of bodies by heat, electricity, and light; mutual decomposition; and chemical isomerism. Under each of these heads we find a considerable amount of most valuable information, skilfully selected from the already immense literature of that subject, and always giving the last results of recent investigations. The work will be thus of a great value for the student, giving in one volume of 800 pages of compact print a reliable and often very complete *exposé* of the results reached by science in this most important department.

Elementary Theorems Relating to the Geometry of a Space of Three Dimensions, and of Uniform Positive Curvature in the Fourth Dimension. By Simon Newcomb. (From the *Journal für Mathematik*, Band lxxxiii., Heft 4, 1877.)

This is an interesting contribution to the subject treated of by Riemann, Helmholtz, and others, and in this country by Prof. Clifford. The question is considered from the standpoint of elementary geometry instead of by the analytic method which has been commonly employed by writers on non-Euclidian Geometry.

Quatre Modèles, représentant des Surfaces développables, avec des Renseignements sur la Construction des Modèles, et sur les Singularités qu'ils représentent. Par V. Malthe-Bruun et C. Crone; *avec Quelques Remarques sur les Surfaces développables et sur l'Utilité des Modèles.* Par M. le Dr. H. G. Zeuthen. (Copenhague, 1877.)

In the third edition of Salmon's "Geometry of Three Dimensions" there is (p. 289) a description of a simple way of making a model of a developable surface, attributed by Prof. Cayley to Mr. Blackburn. This suggested to Dr. Zeuthen the idea of drawing on the same model curves having contact of different orders with the edge of regression (*l'arête de rebroussement*) and of constructing new models of a very elementary nature, showing the principal singularities of developable surfaces.

Full accounts are given in a pamphlet (15 pp.) and direc-

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tions for putting the models together, which consist of flat cardboard marked in accordance with the printed descriptions. The whole is contained in a neat quasi-envelope (nine inches by seven).

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Glass for Reflectors

YOUR last number (vol. xvii. p. 226) contains a very interesting paper by Mr. Norman Lockyer, in which that gentleman quotes the following passages from Mr. Grubb's paper :—

"For the 4-foot disc of glass for the Paris reflector, in place of that which has so recently resulted in failure, the St. Gobain Glass Company require twelve months' time to perfect (although, be it remembered, the quality of the glass is here of no consequence whatever); and I have been myself in correspondence with the principal glass manufacturers here and on the Continent, and not one of them is willing to undertake even a 6-foot glass disc; so that it would appear that, above that size, the silver-on-glass mirrors are out of the question." . . . . "The other great difficulty in the manufacture of reflectors is the annealing of the disc, and I believe it is this difficulty which limits to so narrow an extent the production of glass discs for silver-on-glass mirrors."

It may be interesting to your readers to know that an attempt is now being made to entirely overcome the apparently insurmountable difficulties so clearly pointed out by Mr. Grubb, and to obtain at any time without delay, and at a very small cost, discs of glass suitable for making silvered reflectors from 6 to 8, or even 10 feet in diameter.

It is almost impossible to over-rate the difficulty of producing massive discs of glass such as the one employed for the 47¼-inch reflector of the Paris Observatory, weighing, as it did, no less less than 1,546 lbs. in the rough, for, however carefully annealed such a mass of brittle, slow-conducting material may be, it will always be liable to unequal expansion, deflection, and fracture.

Fortunately, however, we have commercial plate glass to fall back upon; plates of 1 to 1½ inch in thickness can be readily made and perfectly annealed, and it is to the substitution of these large and comparatively thin sheets of glass, in lieu of thick cast masses, that my attention has been chiefly directed.

It is perfectly well known that plates of 1 to 1½ inches in thickness, if of large area, are subject to a great amount of deflection and consequent distortion of the image, which no ordinary support or backing can prevent. Several modes of converting such thin discs of commercial plate glass into efficient reflectors are about to be put to the test of practical experiment for the 50¼-inch silver-on-glass reflecting telescope which I am making and erecting at my residence on Denmark Hill.

Any attempt to support a disc of this diameter of 1½ inch in thickness against a cucheon of any kind, or loosely against a plane, must end in failure; nor can we hope to escape the difficulty by cementing the glass to any foreign substance whose power of conducting heat and rate of expansion differs from that of glass, as a giving way of the cement would be only a question of time, while distortion would result from unequal expansion of the two different materials. An intermediate course has therefore been adopted.

A strongly ribbed hollow cellular casting is made of iron 52½ inches in diameter, and 13 inches in thickness, weighing 1,400 lbs.; after slowly cooling in its mould, it will be again heated to about 900° F., and then be again slowly cooled; the whole of the external skin of the casting will be turned off in the lathe, and its face made into a true plane, less the final process of scraping; it will then be thrice annealed in oil, each time slowly raising the temperature from 60° up to 600° F., and each time slowly cooling it again. When all undue tension has thus been got rid of, its face will be finally scraped to a true plane, and a small spiral channel $\frac{1}{16}$ of an inch deep, and the same in width, will be formed on the flat face, the channels being about ½ an inch apart from each other, and extending from the centre nearly to the outer edge of the metal surface. One side of the glass disc having been previously ground flat by the plate-glass manufacturer, will have a second grinding on the grooved plane, so as to insure perfect contact all over its surface; the emery having been all carefully removed, the surface of the iron plane is to be slightly moistened with olive oil, and the disc of glass replaced upon it. A flanged iron ring will then be placed around the glass disc, and screwed firmly to the iron surface, leaving a clear annular space of about ⅜ of an inch wide between the periphery of the glass disc and the ring; a permanently tenacious viscous matter (of the character of soft marine glue) will then be poured into this annular space, forming an air-tight junction between the iron plate and the glass surface, and at the same time admitting the glass to expand or contract freely. A partial vacuum will then be formed beneath the glass by exhausting the air through a central hole communicating with the spiral groove; the glass disc will then be held firmly in contact with the entire surface of the iron plane, which, however, is free to slide under the glass when undergoing expansion or contraction. I have found by repeated experiments (many years ago) that plate glass (say of ¼ of an inch only in thickness) so held on to an unyielding plane, may be repeatedly struck by the rounded face of a heavy wooden mallet, with the greatest violence, without producing a single fracture, so complete is the support thus afforded.

It is important to bear in mind that a glass disc so held does not rest on its lower edge when placed in a vertical position, nor are the upper portions of the plate allowed to press on, and be supported by the lower ones, as is inevitably the case with a mirror loosely suspended in a sling in the ordinary manner, but on the contrary, every portion of the glass disc is sustained and supported in position by atmospheric pressure, and held flatly and firmly against a corresponding portion of the unyielding iron plane, free from any accumulated downword pressure.

The expansion by heat of plate-glass and cast-iron are in round numbers as 19 is to 22, and the differential amount of this expansion between the extreme range of summer and winter temperatures, would cause the iron to exceed the diameter of the glass by about $\frac{1}{400}$ of an inch;—this minute sliding motion of the two smooth planes upon each other would not in the slightest degree alter the curved face of the mirror.

The glass disc having been thus finally and permanently attached to the iron plane, the latter would be supported in its cell by bands passing round it as usual, and with a system of triangular supports at the back. The weight of this strong-ribbed hollow cellular plane, of 13 inches in thickness, is only 1,400 lbs., while a disc of equal diameter in speculum metal, if only 4¼ inches in thickness, would weigh about 2,700 lbs.; hence such a compound metal and glass reflector is lighter than a solid cast glass one, and but little more than one-half the weight of a reflector made of ordinary speculum metal, while its thickness being three times as great as the latter, it would, when in use, and also while undergoing the polishing operations, be perfectly free from deflection.

Hitherto I have spoken only of the mode of mounting the glass disc on its iron support; it now remains to convert the flat surface of the glass disc into a shallow concave reflector. For this purpose I have made experiments in turning glass concaves with a diamond-cutting tool mounted on a slide-rest, and I have found that in this way glass affords nearly the same facilities for shaping in the lathe that iron or brass would do under similar conditions; it therefore follows that lenses of all shapes and sizes may be brought approximately to a true figure with very great ease and rapidity.

Satisfied with this result, I am now erecting in my laboratory a lathe of peculiar construction and specially adapted to this purpose with a bed fifty feet in length, and having a fifty-four inch diameter face plate at each end of the mandril. A massive radius-bar or frame of double the intended focal length of the reflector, moves on an adjustible pivot attached to the lathe-bed, while the other end of the radius frame carries a slide-rest in which a diamond-cutting tool is mounted, and by means of which a spherical concavity is rapidly and truly turned over the whole face of the glass disc, and of any desired radius, while a second plate of glass or metal is turned into a convex surface on the other face-plate of the lathe, thus furnishing a convex grinder of the exact same radius as the concave reflector. Special arrangements are made to neutralise any difference in the length of the radius-frame by expansion or contraction during the turning operation, and provision is also made for gauging to the

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